Tomatoes

ATLANTIC PROVINCES VEGETABLE CROPS GUIDE TO PEST MANAGEMENT 2002 - 2003

Agriculture and Forestry
Farm Extension Services

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Introduction

Tomatoes belong to the Solanaceae (the nightshade family) along with potatoes, peppers and eggplants. *Lycopersicon esculentum* is a perennial plant in the tropics but in northern climates it is grown as an annual. Botanically this vegetable is a fruit (a berry). Flowers are generally borne in clusters of 4 to 8 but small fruited types may have 30 to 50 flowers per cluster. The flowers are mainly self pollinated by the wind. The fruit has 2 to 18 locules (chambers or sections).

The tomato is a native of the Peru, Bolivia, and Ecuador area of the Andes Mountains. Its antiquity is uncertain in regard to cultivation but it was being cultivated when America was discovered by Europeans. It was not until 1835 that the tomato was considered suitable as a food crop in the northeastern U.S.

Tomatoes respond well to high temperatures. The minimum temperature for seed germination is 10ºC with a maximum temperature of 35ºC and an optimum range of 17 to 20ºC. Most field transplants should not be set out until the danger of frost is past. An optimum growth rate is obtained at 22ºC with reductions occurring above 30ºC and below 12ºC. Fruit setting is inhibited above 30ºC and below 16ºC. Rough fruit

(cat faced) results from growing temperatures below 16°C. Root growth does not occur below 16°C. Tomatoes require adequate, even moisture, particularly at flowering and during fruit set.

Tomatoes grow best in well drained soils that are well supplied with organic matter. Sandy soils are suited for early production, loam and clay loam soils are suited for later production. Shelter from wind is important especially for early production. This crop also benefits from the use of plastics such as ground mulches, row covers, and tunnel houses.

Tunnel house tomato harvest begins about mid-July and field harvest about August 1st. Production continues as long as economically viable, up to late October. Marketable yields of ripe tomatoes vary dramatically with the weather. This range is 10,000 to 30,000 kg per hectare. Tomatoes for green chow may yield as much as 40,000 kg per hectare.

There is a large market for red tomatoes in the Atlantic area within our growing season, especially on the wholesale market. There is still price competition from other areas of North America, and in good growing seasons there are local market "gluts". There is also interest in extending our season with the use of tunnel houses for July and August production. There is a limited market for fresh green tomatoes and a limited processing market. "Sun dried" tomatoes are being processed on a small scale. The warmest areas of the Atlantic provinces can grow red processing tomatoes.

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Crop Establishment

Seeding/Planting - Since tomatoes require a relatively long growing season, they should be started in a greenhouse or hotbed. Approximately 75 to 150 grams of seed are required to produce enough plants for one hectare. Sow seeds eight weeks before plants are to be set in the field or tunnel. A temperature of 27°C for 1 to 2 weeks is required for good seed emergence.

Plants for early crops can be pricked off (when the first true leaves appear) into 5 to 10 cm pots and plants for late production can be pricked off into a module transplant tray, peat block, paper pots or peat pots 4 to 5 weeks before transplanting. Plants should be grown firm and stocky by good light, moderate temperatures and appropriate fertilization. Plants should be developed to the budding stage by the time of transplanting.

Tomato plants can also be raised by sowing raw seed directly into peat pots, module trays (72, 128 or 200 cell trays), or peat blocks. Under such a planting system a superior plant can be raised in a shorter time. This system is less labor intensive and reduces transplant shock.

Tomato plants should be hardened for about one week before transplanting to the field. This can be accomplished by reducing the soil moisture supply and reducing the air temperature to 13 to 16°C. This will improve the survival ability of the plants to

adverse weather conditions when field set.

Tomatoes are normally field set at 11,000 to 18,000 plants per hectare depending on the type of tomato and its field spacing:
(1) Determinate (small-vined) cultivars - plants 45 to 60 cm apart, rows 1 to 1.5 m apart.
(2) Indeterminate (large-vined) cultivars - plants 50 to 90 cm apart, rows 1.5 to 2 m apart.
(3) Staked Tomatoes - plants 45 cm apart, rows 1 to 1.5 m apart.

Tomatoes for processing will have specific requirements.

Nutrient Content: An excellent source of Vitamin C. They are also a source of many minerals including potassium, calcium and folate. One medium raw tomato provides 35 kilocalories.

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Crop Management

Transplanting - set in the field after the danger of frost is past. Set out only relatively young, firm and blossom free plants. Severe hardening reduces yields. To obtain good yields and fruit size, the plants should become established in the field before the first fruits are set. This is important with early determinate cultivars. Use a starter fertilizer solution.

Mulching - black plastic mulch can be used for weed control and higher yields of marketable fruit. Clear plastic mulch is the most effective for early growth and yields. However, weeds must be controlled with the use of herbicides.

Apply mulches when soil moisture is high and well before planting so the soil can heat up.

Hot caps, row covers or tunnels - these are used by growers to foster early growth and production. Ventilation is critical on warm sunny days. Do not allow temperatures around plants to exceed 35°C. Grow cultivars suited to this method of culture. Air blasting is necessary for pollinization of early fruit clusters (flowers must be vibrated).

Staking Tomatoes - advantages in staking, or otherwise training tomato plants off the ground include a frequent increase in the percentage of marketable fruit, easier harvesting, and reduced injury to both plants and fruit in harvesting. It is doubtful that staked yields will differ from unstaked plant yields or that fruits on staked plants are firmer. Staking procedures (many systems are possible) that require little pruning seem best because pruning is costly, and removing laterals means removing potential flower clusters, so both early and total yields per plant are often reduced. The practices of staking and pruning most are likely to be profitable when a long harvest season is possible and fairly uniform production over the season is desired. (Only staking greenhouse cultivars should be used in tunnel houses and a limited number of trusses should be allowed to set depending on the intended market and season).

Irrigation - the soil moisture should be kept at a reasonable level to reduce the incidence of cracking and blossom end rot from wide fluctuations in soil moisture. A fixed irrigation system may be used for frost control at planting time or late in the fall. Trickle irrigation may be used in the field or in tunnel houses with or without soil mulches.

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Nutrition

ALL ADDITIONS OF LIME AND FERTILIZER OR MANURES SHOULD BE BASED ON RECOMMENDATIONS FROM A SOIL TEST.

Manures - Often they are used in tomato production but one has to be careful of excessive nitrogen since delayed maturity and excessive vegetative growth may result.

Lime - Lime should be applied to maintain the soil pH in the range 6.5 to 6.8. A high pH will usually ensure a high calcium level which is necessary for this crop.

Nitrogen - Nitrogen is best applied at the time of planting and broadcast at an appropriate level, since an excess will delay maturity of ripe tomatoes. Soil organic matter and rotations have to be carefully considered for N contribution. Foliar sprays of calcium nitrate or urea may be used to apply some additional nitrogen. Where plastic mulches are used the nitrogen application should be low since the nitrogen does not leach. Approximately 50 kg per hectare or less of nitrogen may be enough for fresh market vigorous cultivars planted into plastic mulch. Maturity may be delayed two to three weeks or more by an excessive application of nitrogen. Total yields of green plus ripe fruit are usually larger but early ripe yields are drastically reduced. For green chow tomatoes heavier rates of nitrogen should be used. Trickle irrigation can be used for fertilization. For processing tomatoes the nitrogen rate will vary greatly depending on the variety, soil type, crop rotation, organic matter and soil management.

Phosphorus - It is most effectively used when banded at the time of transplanting especially when small quantities of fertilizer are being applied. Band at least 50 kg of phosphorus per hectare. Use a transplant solution if possible especially on low phosphorus soils

Potash - Broadcast potash requirements before planting and incorporate it into the soil along with the nitrogen. Banded potash can hurt yields at 60 kg per hectare.

Magnesium - On sandy soils low in organic matter and in magnesium content, foliar applications of epsom salts should be considered.

Calcium - On sandy soils low in calcium apply foliar sprays of calcium nitrate to prevent blossom end rot (adjust nitrogen accordingly).

Micronutrients *Boron* - Tomatoes have a high boron requirement. Apply a boronated fertilizer and apply at least one foliar spray of soluble boron.

Application Method - Nitrogen and potash should be broadcast prior to planting and incorporated into the soil. Banded nitrogen and potash can be detrimental to early and total yields. Phosphorus would be best banded and starter solutions should always be used. More fertilizer may be needed on staked cultivars.

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Pests and Pest Control

Weeds

Control perennial weeds prior to planting. Many growers use black plastic mulch for weed control, especially when the crop is grown under plastic row tunnels. Most herbicides recommended for use on tomatoes will not provide complete control of annual weeds and supplemental cultivation is usually necessary. Often contact herbicides are used to burn weeds from between the rows of plastic mulch. (Use shields to prevent drift onto the crop).

Diseases

Damping Off (fungi)

Characteristics: Seed may decay, fail to emerge or once emerged develop water soaked discolored areas on the stem which withers and causes the plant to fall over. Disease incidence and severity is increased by cold temperatures, over watering, high humidity and over crowding.

Control: Hot water treat seed and apply a fungicide seed protectant. Plant seeds at the recommended rate into sterilized seeding mix and flats. Supply adequate moisture but do not overwater and maintain night temperatures above 16ºC. Drench immediately after seeding with a fungicide and if damping off occurs continue to apply fungicides at weekly intervals.

Sclerotinia (white mold)

Characteristics: This disease affects the stems of tomato plants especially those being grown on the ground. Fields selected for production should be as free as possible from this disease as it can survive from many years in the soil by means of a hard Sclerotia (resting fungal nuggets).

Control: Rotate with corn or other grass species. Do not rotate with other vegetable crops, soybeans, field beans or canola. Do not allow weeds to grow out of control. When using over head irrigation do not over apply. Plastic mulches on the ground will help in combination with trickle irrigation to prevent disease development.

Septoria Leaf Spot (fungus)

Characteristics: Causes numerous small grayish circular leaf spots with dark borders. Survives in crop residue and on seed. Wet weather favours disease development.

Control: Hot water treat seed. Apply protective fungicide sprays on a regular basis. Plow down crop residue immediately following harvest.

Early Blight (fungus)

Characteristics: Leaf spots are dark brown to black with concentric rings or zones within the spot. On fruit, large, dark, sunken areas develop particularly at the calyx end or on growth cracks.

Control: Apply fungicide sprays if required. Healthy plants which are not stressed can tolerate some leaf spotting.

Late Blight (fungus)

Characteristics: Irregular greenish black water soaked areas appear on older leaves. Infected fruit remains firm but becomes rough with greasy greenish-brown patches. This disease is more common under cool moist conditions and is the same fungus which causes late blight of potatoes. A new strain of blight is now well established in this region and is extremely aggressive on tomatoes.

Control: Apply fungicide sprays. Do not plant near potato fields. Control cull potatoes from the previous season. See the Atlantic Provinces Potato Guide for more detail.

Anthracnose (fungus)

Characteristics: Common rot of ripe fruit causing circular sunken spots which develop dark centres. Infection by other secondary organisms may cause complete rotting of fruit. Fruit becomes more susceptible as it ripens.

Control: Apply fungicide sprays. Follow a 3 year rotation.

Botrytis Rot (fungus)

Characteristics: Gray mold rot of foliage, stem and fruit occurs. Pale green silvery ring marks with a brownish puncture in the center, known as ghost spot, occurs on the green fruit. The same rings are generally yellow on ripe fruit. This disease is associated with wet, humid weather. This is a serious disease of tomatoes every year and is a major cause of fruit rot.

Control: Use fungicides for control in tunnel house or field.

Bacterial Speck and Spot (bacterium)

Characteristics: These two bacterial diseases are spread by seed and transplants and can overwinter from the previous year's diseased crop. Most spread takes place during transplant production and is increased by high humidity. Symptoms include black spots on the leaves with a yellow border and small dark spots on the fruit.

Control: Hot water treat the seed and apply a fungicide seed protectant. Use sterilized soil in the greenhouse and disinfect flats. If these diseases appear in the greenhouse or field, apply appropriate fungicide plus copper sprays. Premixing the spray for 90 minutes or longer (overnight) increases efficacy. If tomatoes are staked use a disinfectant on used stakes. Follow at least a two year rotation.

Bacterial Canker (bacterium)

Characteristics: This bacterial disease is seed borne and can overwinter for one year in infected plant debris. Leaves wilt, die and brown cankers develop on the stem. White spots develop on the fruit with dark corky centers.

Control: Hot water treat the seed and apply a fungicide seed protectant. Use sterilized seeding mix and disinfect flats and tools. Do not plant into fields which have been infested for at least two years.

Virus Diseases

Tomato Mosaic: Leaves and occasionally green fruit are mottled with light and dark green patches. Fruit may ripen unevenly and have internal brown streaks. This highly infectious virus can be spread simply by touching infected plants.

Cucumber Mosaic: Infected plants are stunted with distorted (shoestring) leaves. Most disease spread is by aphids feeding first on diseased plants and then on healthy.

Double Virus Streak: This disease is caused by infection of the plant by both tomato mosaic and PVX virus. Infected plants have mottled leaves, brown streaks on the stems and petioles and brown greasy blotches on the fruit.

Control: Keep young plants virus-free by sanitation measures and aphid control. Avoid unnecessary handling of plants. Infections of older, well developed plants do not affect yield appreciably.

Grow seedlings away from mature tomato plants. Eradicate weed hosts in or near the greenhouse. Do not keep ornamentals in the same greenhouse with tomato seedlings. Do not smoke or chew tobacco when handling plants. Wash hands with soap (trisodium phosphate, a detergent, is best) and water before handling tomato plants. Do not harden transplants by leaving them in headlands or other weedy places. Do not use cultivators in an infected crop and then in a healthy one.

Non-Parasitic Disorders

Blossom-end Rot

A physiological disorder. Lack of adequate soil moisture and insufficient calcium uptake from the soil to the fruits during dry weather have been shown to cause this disorder. Excessive magnesium, potassium, sodium, or ammonium salts, or a deficiency of soluble calcium salts, all tend to decrease calcium uptake.

Control: Timely irrigation will reduce or prevent this disorder. If drought occurs, and irrigation is not possible, cultivation should be very shallow to reduce water loss. Hoeing or cultivating should be done no closer than 30 cm from the plants to avoid root pruning. Maintain a high organic matter content in the soil and a high soil pH. Spray applications of calcium nitrate or a preplant application of gypsum will help control this disorder.

Blotchy Ripening

Characteristics: Blotchy Ripening is a disorder which involves irregular fruit ripening. Slow growth due to plant stress seems to be the cause.

Control: Eliminate heat or moisture stress wherever possible.

Yellow Shoulder

Characteristics: Climatic conditions prevent the red pigment from developing in the wall tissue near the stem. The shoulders of the tomato then became deep yellow in color. Cultivars with green shoulders are more susceptible and high temperatures during the growing season aggravate this problem. Fruits exposed to direct sunlight appear to be the most susceptible.

Control: Avoid susceptible cultivars and protect crops from high temperatures where possible.

Insects

Cutworm

Characteristics: Sometimes a serious problem especially near grassy margins of fields. Occasionally it can be a widespread problem.

Control: Control couch grass and then perennial weeds in the year prior to planting. Apply chemical sprays as necessary.

Flea Beetles

Characteristics: Adults are 1.5 to 3 mm long, black or bronze beetles. Their hind legs are well developed for jumping. The white larvae are in the soil, and therefore seldom seen. Depending on species, there are one or two generations a year. Adults overwinter in the soil. Eggs are laid on or near the roots where larvae feed. Mature larvae pupate in the soil near the host plant. Adults emerge in early August for single-generation species. Last-generation adults feed on foliage until fall, when they return to the soil to overwinter.

Control: Before transplanting, lightly spray the plants in the flats with a field spray insecticide. Watch closely in the field as damage may occur suddenly and an insecticide may be needed.

Tomato Fruit Worm (Corn earworm)

Characteristics: This pest is not usually a serious problem. Larvae feed on the fruit. See Corn Guide for description. During years of high populations of this insect, damage can be severe when pesticides are not used in a preventative manner.

Control: The insecticides applied for flea beetles will control this pest.

The Colorado Potato Beetle

Characteristics: The Colorado Potato Beetle is an occasional pest. Larvae feed on leaves.

Control: Insecticides applied for the flea beetle will control this pest. Insecticide resistance can be a problem.

Wireworm

Characteristics: Early in the spring, adult wireworms (click beetles) lay their eggs around grass roots. The larvae hatch in about a week and, depending on the species, will live for 1 to 5 years in the ground feeding on roots and seeds. Wireworms require 3 or more years to complete their life cycle. Wireworms of all sizes and ages are present in the soil throughout the year as there is always an overlapping of generations. The wireworms, or larvae, are yellow, white or darker shades of brown. Fully developed larvae may be 1.2 to 4 cm long and have a hard, smooth surface. When a larva is mature, it pupates in the fall. It then becomes an adult beetle and waits until spring to emerge. Wireworms are often numerous in land that has been in sod for several years. They are also more abundant in heavy poorly drained soil.

Wireworms are sometimes confused with millipedes. Millipedes have numerous pairs of legs and coil up when disturbed, while wireworms have three pairs of legs near the front of the body and do not coil up. Monitor fields prior to planting and

Control: Monitor fields prior to planting and avoid planting crops highly susceptible to wireworms in a field that has been recently in sod. See appendix III in the Guide to Pest Management for Vegetable Crops.

SPECIFIC CHEMICAL CONTROLS FOR THE VARIOUS CROP PESTS DISCUSSED MAY BE FOUND IN THE 'GUIDE TO PEST MANAGEMENT' FOR VEGETABLE CROPS.

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Harvesting and Handling

Pick fruit at the ripe, pink or mature-green stage depending on its use and distance to market. At about 21°C, pink fruits ripen in 1 to 2 days and mature-green fruits in 4 to 5 days. Exposure of green fruit to ethylene supplied as a gas to harvested fruit, or as a field spray of ethephon, accelerates ripening. Prolonged exposure to temperatures above 30°C can inhibit red pigment formation.

Ethephon is used for field ripening of processing tomatoes for once over harvesting.

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Storage and Conditioning

Mature-green tomatoes should be stored at 13°C to 21°C. Optimum temperatures for ripening are between 18°C to 21°C, while 14°C to 16°C is most desirable for slowing ripening without increasing decay. Firm ripe fruit can be held as low as 7°C to 10°C (pink fruit are stored at intermediate temperatures, 10 to 15°C). Relative humidity in all cases should be 90 to 95%. Mature green fruit can be held 2 to 6 weeks while ripe fruit can only be held 1 week in conventional storage. Controlled atmosphere storage may be used to delay ripening and extend storage life. Botrytis and Alternaria rots may be a problem, especially if fruit have been chilled in the field or in storage.

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(See also General References)

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PEST	PESTICIDE (Formulation)	RATE Product	DAYS TO HARVEST	REMARKS
Weeds				

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Preplant	ROUNDUP 356 Sn	2.5 to 7.0 L/ha	-	Apply in the fall or spring prior to planting. Annual weed control programs will be necessary

Perennial Weeds including quackgrass	TOUCHDOWN 480	2.5 to 7.0 L/ha	-	to control weeds germinating after planting. For quackgrass control apply to actively growing quackgrass when at least 4 new leaves are present. The low rate (2.5 L/ha) will provide a minimum of one season control, while higher rates (4.75 to 7 L/ha) will provide longer term control. The low rate of Roundup should be applied in 50 to 100 L/ha water. If higher water volumes are used add a suitable surfactant. Wait 72 hours before plowing under. Best control of quackgrass is obtained when these herbicides are applied in the fall.
	GLYFOS	2.5 to 7.0 L/ha	-	
	ROUNDUP TRANSORB	2.5 to 7.0 L/ha	-	
Preplant Incorporated Primarily annual grasses and some broadleaf weeds	DEVRINOL 50 DF	2.25 to 4.5 kg/ha	-	Preplant incorporate to 2.5 to 5 cm soon after application to a dry, clod-free soil. For use on mineral soil only. Use lighter rates on lighter soils.
	trifluralin:			Incorporate within 8 hours of application following label instructions. Ragweed and mustards are not controlled. Corn or cereal grains may be injured when planted in fields treated with trifluralin the previous year.
	TREFLAN 480 EC	1.1 to 2.1 L/ha	-	
	RIVAL 60 DF	1.0 to 1.9 kg/ha	-	
	TRIFLURALIN 400 EC	1.5 to 2.75 L/ha	-	
Preplant Incorporated to annual grasses	DUAL II	2.0 to 2.75 L/ha	-	Preplant incorporate to a depth of 10 cm. Use only on transplanted tomatoes, grown for processing.
	DUAL II MAGNUM	1.25 to 1.75 L/ha	-	
Preplant Incorporated Germinating annual grasses and broadleaf weeds	DUAL II plus SENCOR 500 F	2.0 to 2.75 L/ha 0.5 to 1.4 L/ha	-	Apply to transplanted tomatoes only. Damage may occur if transplants are weak.
PPI followed by Postemergence	metribuzin: SENCOR 500 F SENCOR 75 DF	Rates vary according to treatment and formulation	-	Processing tomatoes only. SENCOR can be used in several ways: (i) 0.5 to 1.4 L/ha SENCOR 500 F or 0.33 to 0.9 kg/ha SENCOR 75 DF can be tank mixed and incorporated with TREFLAN; (ii) or 0.6 to 1.7 L/ha SENCOR 500 F, or 0.32 to 1.1 kg/ha SENCOR 75 DF can be applied as a postemergence spray directed to the bottom one-third of tomato plants established at least 3 weeks; (iii) Multiple Application Techniques; apply postemergence before weeds are 4 cm in height. Re-applications can be made as new flushes of weeds emerge. Do not exceed more than four applications per year. SENCOR 500 F 0.3 L/ha. Avoid application during cool, cloudy, wet weather. Use lower rates on sandy soils. Refer to label for control. Emerged annual broadleaf weeds and annual grasses, including triazine resistant species.
Postemergence Annual Grasses	EXCEL SUPER 80.5	0.67 L/ha	55	Apply to grasses in the 1 to 6 leaf stage.

Emerged annual grasses	FUSILADE II 125 EC	0.6 to 1.0 L/ha	60	For volunteer cereal and barnyard grass control, apply 0.8 L Fusilade per hectare at the 2 to 5 leaf stage. For crabgrass and wild oats, use 1.0 L per hectare at the 2 to 5 leaf stage. Foxtail grasses require 1.0 L per hectare at the 2 to 4 leaf stage.
	POAST Ultra EC plus ASSIST oil conc. or MERGE	0.32 to 0.47 L/ha 2 L/ha 1.0 L/ha	60	Apply postemergence to annual grasses in the 1 to 6 leaf stage.
Emerged annual broadleaf weeds (1-4 lf) and grasses (1-3 lf) including triazine resistant weeds	LENTAGRAN 45 WP plus SENCOR 75 DF or SENCOR 500 F	1 to 2.0 kg/ha 0.2 to 0.4 kg/ha 0.3 to 0.6 L/ha	-	Use trifluralin PPI. Then apply Lentagran plus Sencor/Lexone as a directed spray to bottom one third of well established tomato plants. See label. This treatment has not been evaluated under Maritime conditions. Use with caution. Do not use before tomato plants reach the 5 leaf stage.
Emerged quackgrass	FUSILADE II 125 EC	1.0 to 2.0 L/ha	60	Apply at 1 to 2 L/ha at the 3 to 5 leaf stage of actively growing quackgrass. 1 L/ha suppresses quackgrass top growth.
	POAST 184 EC plus MERGE or ASSIST	2.7 L/ha 2 L/ha 4 L/ha	60	Apply at 1 to 3 leaf stage of actively growing quackgrass. Apply in 110 to 200 L/ha of water. Use merge at 1% volume/volume of water.
Emerged Annual Weeds Inter-row shielded	GRAMOXONE 200 Sn	2.75 to 5.5 L/ha	-	Do not spray solution on the crop plant since it could be injured or killed. Use Gramoxone for best control of grasses.
	REGLONE 200 Sn	2.75 to 5.5 L/ha	-	
Insects				▲ to Top
Cutworms (preplant)			-	See -"Control of Wireworms, White Grubs, Cutworms and Slugs".
Climbing cutworms	SEVIN 85 S	275 g/1000 m row	1	Spray in 25 to 30 cm band over the row. Use at least 225 to 275 L/ha spray.
	SEVIN 80 SP	3.0 kg/ha	1	
	SEVIN XLR 43 SU	333 to 416 ml/ 1000 m row	1	
	SEVIN L 420 SU	360 ml/1000 m row	1	
	LORSBAN 400 EC	2.4 L/ha	50	Apply once, when damage first appears.
	LANNATE 90 SP	270 to 540 g/ha	1	Apply in early morning or late evening.
	LANNATE 215 L	1.25 to 2.25 l/ha	1	

Flea beetles	THIODAN 4 EC	1.5 to 2.75 L/ha	2	Apply when insects first appear. Repeat as necessary. Apply in sufficient water for complete coverage.
	ENDOSULFAN 50 WP	1.1 kg/ha	2	
	THIODAN 50 WP	1.0 to 2.25 kg/ha	2	
	GUTHION 240 EC	2.25 to 3.5 L/ha	2	
	SNIPER 240 EC	2.25 to 3.5 L/ha	-	
	GUTHION 50 WP	1.1 to 1.75 kg/ha	2	
	SNIPER 50 WP	1.1 to 1.75 kg/ha	-	
	APM 50 WP	0.85 to 1.1 kg/ha	2	
	CYMBUSH 250 EC	140 mL/ha	3	
	SEVIN XLR PLUS	1.25 L/ha	2	
	SEVIN 85 S	1.25 to 2.75 kg/ha	1	
	SEVIN 80 S	1.5 kg/ha	1	
Tomato fruitworm (corn earworm)	DIPEL WP	1.1 kg/ha	0	Moths lay eggs sporadically from mid July to the end of the season. Spray if necessary.
	THIODAN 4 EC	2.75 L/ha	2	
	ENDOSULFAN 50 W	2.25 kg/ha	2 to 7	
	THIODAN 50 WP	2.25 kg/ha	2	
	GUTHION 50 WP	0.85 to 1.1 kg/ha	2	
	SNIPER 50 WP	0.85 to 1.1 kg/ha	-	
	APM 50 WP	0.85 to 1.1 kg/ha	2	
	APM 240 EC	1.7 to 2.2 L/ha	2	
	SNIPER 240 EC	1.7 to 2.2 L/ha	-	
	SEVIN XLR PLUS	2.5 to 5.25 L/ha	2	
	SEVIN 50 W	2.25 to 4.5 kg/ha	1	
	SEVIN 85 S	1.25 to 2.75 kg/ha	1	
	SEVIN 80 S	1.5 to 3.0 kg/ha	1	
	LANNATE 90 SP	270 to 540 g/ha	1	
Colorado Potato Beetle	ADMIRE 240 FS	0.92 to 1.3 L/ha	-	Equivalent rate to 7-10 ml per 100 meter of row applied as drench in transplant water or through

				application kit as a soil treatment at planting.
	DECIS 2.5 EC	200 to 300 mL/ha	3	3 applications per year.
	DECIS 5 EC	100 to 190 mL	3	
	NOVODOR EC	4.0 to 8.0 L/ha	C	B.t. tenebrionis.
	GUTHION 240 SC	1.75 L/ha	4	Minimum re-entry period of 48 hours.
	CYMBUSH 250EC	0.14 L/ha	3	
	MATADOR 120EC	0.08 to 0.125 L/ha	7	Use higher rate for larger insects or high populations. Minimum re-entry period is 24 hours.
	ADMIRE 240 F	0.2 L/ha	7	Make a maximum of two foliar sprays at least 5 days apart per season. Do not make a foliar application after a soil application of ADMIRE in the same crop.
Diseases				▲ to Top
Damping off	CAPTAN 50 WP	125 to 225 g /100 m^2	-	Use as a dust treatment to soil or in 50 to 85 L of water per 100 m^2. Work into the upper 8 to 10 cm of soil before planting.
	CAPTAN 80 WP	1.5 kg/1000 L	-	Apply 50 to 85 L per 100 m^2. Work into upper 7.5 to 10 cm of soil before planting.
	MAESTRO 75 DF	1.5 kg/1000 L	-	
Bacterial speck Bacterial spot	MANEB 80 WP	3.25 kg/ha	7	Tank mix FIXED COPPER according to manufacturer's directions with one of these fungicides. This disease is difficult to control once established in a field. Spray early at 7 to 10 day intervals. Pre-mix the two fungicides for 90 minutes prior to use. All products must be tank mixed with fixed copper.
	DITHANE M-22 80 WP	3.25 kg/ha	7	
	DITHANE 75 DG	1.1 to 3.25 kg/ha	7	
	PENNCOZEB 75 DF	1.1 to 3.25 kg/ha	7	
	DITHANE M-45 80 WP	1.75 to 3.25 kg/ha	7	
	MANZATE 200 80 WP	1.75 to 3.25 kg/ha	7	
	MANZATE 200 75 DF	1.75 to 3.25 kg/ha	7	
Anthracnose, Early Blight, Late Blight, *Septoria* leaf spot	BRAVO 500 F	2.4 to 4.0 L/ha	1	Begin spraying in mid July and continue at 7 to 14 day intervals. Use shorter interval under continuously wet weather.
	DITHANE DG	1.1 to 3.25 L/ha	7	
	DITHANE M-45 80 WP	3.25 kg/ha	7	
	MANZATE 200 80 WP	3.25 kg/ha	7	
	MANZATE 200 75 DF	1.75 to 3.25 kg/ha	7	